

2015004693_양상헌

실행환경: MAC OS TERMINAL(MACBOOK PRO 2015 RETINA, MOJAVE 10.14.6), ANACONDA

1. Source Code:

- Assignment5 폴더 참조 (DL_HW_05week.py & DL_HW_04week.py)

"DL_HW_04week.py" 는 Dropout 을 적용하지 않고, 기본적인 Gradient Descent Optimizer를 적용했던 4주차 과제 파일이고, "DL_HW_05week.py" 는 이번주 과제인 Dropout 과 ADAM Optimizer를 "DL_HW_04week.py"에 적용한 것이다.(Dropout Probability 는 70% 로 설정하였고, ADAM Optimizer에서 beta1=0.6, beta2=0.8, epsilon=0.1, learning_rate=0.9 로 설정하였다.) 결과 비교를 위해 두개의 파일을 모두 추가하였다.

2. Result & Comparison:

*NO-Dropout & Gradient Descent Optimizer (HW04)

(출력물 중간 생략)

```

assignment5 --bash -80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_04w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]

assignment5 --bash -80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_04w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/tra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'iType' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, 1, 1) / '(1,type)'.
  _np_qint16 = np.dtype [("qint16", np.int16, 1)]

assignment5 --bash -80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_04w
eek.py
Colocations handled automatically by placer.
2020-04-22 00:31:24.695402: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:31:24.697585: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op
parallelism_threads for best performance.
Epoch: 1 cost = 1.680774523
Epoch: 2 cost = 0.230153091
Epoch: 3 cost = 0.144567394
Epoch: 4 cost = 0.128581529
Epoch: 5 cost = 0.102995661
Epoch: 6 cost = 0.084082711
Epoch: 7 cost = 0.069307209
Epoch: 8 cost = 0.056512397
Epoch: 9 cost = 0.046855795
Epoch: 10 cost = 0.036827086
Epoch: 11 cost = 0.030891188
Epoch: 12 cost = 0.024448925
Epoch: 13 cost = 0.019546618
Epoch: 14 cost = 0.015512443
Epoch: 15 cost = 0.012691728
Accuracy: 0.9651
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

assignment5 --bash -80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_04w
eek.py
Colocations handled automatically by placer.
2020-04-22 00:31:24.695402: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:31:24.695628: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op
parallelism_threads for best performance.
Epoch: 1 cost = 1.680774523
Epoch: 2 cost = 0.230153091
Epoch: 3 cost = 0.144567394
Epoch: 4 cost = 0.128581529
Epoch: 5 cost = 0.102995661
Epoch: 6 cost = 0.084082711
Epoch: 7 cost = 0.069307209
Epoch: 8 cost = 0.056512397
Epoch: 9 cost = 0.046855795
Epoch: 10 cost = 0.036827086
Epoch: 11 cost = 0.030891188
Epoch: 12 cost = 0.024448925
Epoch: 13 cost = 0.019546618
Epoch: 14 cost = 0.015512443
Epoch: 15 cost = 0.012691728
Accuracy: 0.9653
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

```

(4)

(5)

Overall :

(1) ~ (5) 총 5번 실행 후 결과를 확인해보면 대체적으로 거의 비슷한 정도의 정확도(약 96.5%)가 나오는 것을 확인할 수 있다. 또한 1Epoch이 진행될 때마다 변화하는 Cost의 양이 일정하게 점진적으로 줄어드는 경향을 확인 할 수 있어 안정적으로 학습이 잘 이뤄진다고 볼 수 있을 것 같다.

*Dropout & ADAM Optimizer (HW05)

(출력물 중간 생략)

(1)

(2)


```
assignment5 -- -bash -- 80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint8 = np.dtype([('qint8', np.int8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint8 = np.dtype([('quint8', np.uint8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint16 = np.dtype([('qint16', np.int16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint16 = np.dtype([('quint16', np.uint16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
Assignment5 -- -bash -- 80x24
prob'.
2020-04-22 00:47:53.238445: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:47:53.238682: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 9.584451971
Epoch: 2 cost = 7.556138261
Epoch: 3 cost = 6.59567874
Epoch: 4 cost = 6.289285069
Epoch: 5 cost = 6.022961885
Epoch: 6 cost = 5.762157595
Epoch: 7 cost = 5.477833385
Epoch: 8 cost = 5.266797233
Epoch: 9 cost = 4.912567928
Epoch: 10 cost = 4.478991353
Epoch: 11 cost = 4.117992128
Epoch: 12 cost = 3.948997378
Epoch: 13 cost = 3.781438742
Epoch: 14 cost = 3.415118356
Epoch: 15 cost = 2.903956426
Accuracy 0.2967
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

assignment5 -- -bash -- 80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint8 = np.dtype([('qint8', np.int8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint8 = np.dtype([('quint8', np.uint8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint16 = np.dtype([('qint16', np.int16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint16 = np.dtype([('quint16', np.uint16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
Assignment5 -- -bash -- 80x24
prob'.
2020-04-22 00:51:54.329832: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:51:54.330033: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 15.982481794
Epoch: 2 cost = 13.138551835
Epoch: 3 cost = 11.084818285
Epoch: 4 cost = 10.118411667
Epoch: 5 cost = 9.158744692
Epoch: 6 cost = 8.937118819
Epoch: 7 cost = 8.688283170
Epoch: 8 cost = 8.479879895
Epoch: 9 cost = 8.733346369
Epoch: 10 cost = 8.607372861
Epoch: 11 cost = 8.448822086
Epoch: 12 cost = 7.589126231
Epoch: 13 cost = 7.653621393
Epoch: 14 cost = 7.647468838
Epoch: 15 cost = 7.325326866
Accuracy 0.1028
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

assignment5 -- -bash -- 80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint8 = np.dtype([('qint8', np.int8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint8 = np.dtype([('quint8', np.uint8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint16 = np.dtype([('qint16', np.int16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint16 = np.dtype([('quint16', np.uint16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
Assignment5 -- -bash -- 80x24
prob'.
2020-04-22 00:54:57.454905: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:54:57.455433: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 5.717872482
Epoch: 2 cost = 3.224197870
Epoch: 3 cost = 2.815843399
Epoch: 4 cost = 2.696247789
Epoch: 5 cost = 2.661643958
Epoch: 6 cost = 2.639717984
Epoch: 7 cost = 2.643487832
Epoch: 8 cost = 2.650139188
Epoch: 9 cost = 2.418949896
Epoch: 10 cost = 2.287264488
Epoch: 11 cost = 1.969659549
Epoch: 12 cost = 1.636251537
Epoch: 13 cost = 1.325218698
Epoch: 14 cost = 1.042713580
Epoch: 15 cost = 0.984266542
Accuracy 0.9282
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

assignment5 -- -bash -- 80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint8 = np.dtype([('qint8', np.int8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint8 = np.dtype([('quint8', np.uint8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint16 = np.dtype([('qint16', np.int16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint16 = np.dtype([('quint16', np.uint16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
Assignment5 -- -bash -- 80x24
prob'.
2020-04-22 00:58:15.682594: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 00:58:15.682885: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 7.793433559
Epoch: 2 cost = 5.612876195
Epoch: 3 cost = 4.425521887
Epoch: 4 cost = 3.923983766
Epoch: 5 cost = 3.762946861
Epoch: 6 cost = 3.435723132
Epoch: 7 cost = 2.722658885
Epoch: 8 cost = 2.720874841
Epoch: 9 cost = 2.780148732
Epoch: 10 cost = 2.697519671
Epoch: 11 cost = 2.499897187
Epoch: 12 cost = 2.387063153
Epoch: 13 cost = 2.318459737
Epoch: 14 cost = 2.158619487
Epoch: 15 cost = 2.051293714
Accuracy 0.4329
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

assignment5 -- -bash -- 80x24
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint8 = np.dtype([('qint8', np.int8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint8 = np.dtype([('quint8', np.uint8, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_qint16 = np.dtype([('qint16', np.int16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
_np_quint16 = np.dtype([('quint16', np.uint16, 1)])
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or 'i'type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
Assignment5 -- -bash -- 80x24
prob'.
2020-04-22 01:01:17.032667: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 01:01:17.032912: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 6.048789258
Epoch: 2 cost = 3.678891371
Epoch: 3 cost = 2.654728120
Epoch: 4 cost = 2.372919282
Epoch: 5 cost = 2.353608516
Epoch: 6 cost = 2.295808975
Epoch: 7 cost = 2.141861936
Epoch: 8 cost = 2.031554478
Epoch: 9 cost = 1.833919416
Epoch: 10 cost = 1.367398134
Epoch: 11 cost = 0.995415295
Epoch: 12 cost = 0.861338898
Epoch: 13 cost = 0.789319338
Epoch: 14 cost = 0.735889198
Epoch: 15 cost = 0.707678849
Accuracy 0.9461
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$
```

```
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$ python3 DL_HW_05w
eek.py
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:526: FutureWarning: Passing (type, 1) or '1type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
    _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:527: FutureWarning: Passing (type, 1) or '1type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
    _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:528: FutureWarning: Passing (type, 1) or '1type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
    _np_qint8 = np.dtype [("qint8", np.int8, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:529: FutureWarning: Passing (type, 1) or '1type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
    _np_qint16 = np.dtype [("qint16", np.int16, 1)]
/opt/anaconda3/envs/tensorflow/lib/python3.7/site-packages/tensorflow/python/fra
mework/dtypes.py:530: FutureWarning: Passing (type, 1) or '1type' as a synonym o
f type is deprecated; in a future version of numpy, it will be understood as (ty
pe, (1,)) / '(1,)type'.
    _np_qint16 = np.dtype [("qint16", np.int16, 1)]
...
2020-04-22 01:04:12.944487: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 01:04:12.944946: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 4.898319588
Epoch: 2 cost = 3.335138885
Epoch: 3 cost = 3.057151030
Epoch: 4 cost = 3.041618223
Epoch: 5 cost = 2.728441327
Epoch: 6 cost = 2.420860126
Epoch: 7 cost = 1.987508489
Epoch: 8 cost = 1.340716717
Epoch: 9 cost = 1.049019449
Epoch: 10 cost = 0.889781612
Epoch: 11 cost = 0.798783476
Epoch: 12 cost = 0.762764948
Epoch: 13 cost = 0.728663686
Epoch: 14 cost = 0.702740787
Epoch: 15 cost = 0.683470638
Accuracy 0.9477
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

...
2020-04-22 01:07:15.085311: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 01:07:15.085569: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 13.438311568
Epoch: 2 cost = 9.825071135
Epoch: 3 cost = 8.031879037
Epoch: 4 cost = 7.286365160
Epoch: 5 cost = 6.692739892
Epoch: 6 cost = 6.564332849
Epoch: 7 cost = 6.440759852
Epoch: 8 cost = 6.591419449
Epoch: 9 cost = 6.525118370
Epoch: 10 cost = 6.051899418
Epoch: 11 cost = 6.075736303
Epoch: 12 cost = 6.179592355
Epoch: 13 cost = 5.924937702
Epoch: 14 cost = 5.724573448
Epoch: 15 cost = 4.903526851
Accuracy 0.2061
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$

...
2020-04-22 01:10:14.656984: I tensorflow/core/platform/cpu_feature_guard.cc:141]
Your CPU supports instructions that this TensorFlow binary was not compiled to
use: SSE4.1 SSE4.2 AVX AVX2 FMA
2020-04-22 01:10:14.657236: I tensorflow/core/common_runtime/process_util.cc:71]
Creating new thread pool with default inter op setting: 4. Tune using inter_op_
parallelism_threads for best performance.
Epoch: 1 cost = 6.523927347
Epoch: 2 cost = 4.174735853
Epoch: 3 cost = 4.159712224
Epoch: 4 cost = 3.478123852
Epoch: 5 cost = 2.691889651
Epoch: 6 cost = 1.914292748
Epoch: 7 cost = 1.238127223
Epoch: 8 cost = 0.967684869
Epoch: 9 cost = 0.851180875
Epoch: 10 cost = 0.786845822
Epoch: 11 cost = 0.743465807
Epoch: 12 cost = 0.707569675
Epoch: 13 cost = 0.692432380
Epoch: 14 cost = 0.656939859
Epoch: 15 cost = 0.637981697
Accuracy 0.9579
(tensorflow) yangsangheonui-MacBook-Pro:assignment5 SangheonY$
```

Overall :

(1)~(10) 총 10번 실행 후 결과를 확인해 보면 앞서 실행해뒀던 No-Dropout & GD Optimizer일 때와는 다른 경향의 결과가 나오는 것을 확인할 수 있다. 총 10번의 실행에서 90% 이상의 정확도가 나오는 경우는 총 6번((1)-0.9483, (2)-0.939, (5)-0.9282, (7)-0.9461, (8)-0.9477, (10)-0.9479)밖에 되지 않는다. 그 외에 4번((3)-0.2967, (4)-0.1028, (6)-0.4329, (9)-0.2061)의 결과에서는 10% 1회, 20% 1회, 30% 1회, 43% 1회의 결과를 확인할 수 있었는데, 앞선 No-Dropout & GD Optimizer일 때보다 정확도의 측면에서 좋지 않은 결과가 나온다고 할 수 있다. 또한 1Epoch이 진행될 때마다 변화하는 Cost의 양이 일정하게 점진적으로 줄어들지 않을 때가 앞선 결과에 비해 덜 안정적으로 학습이 이뤄진다고 볼 수 있을 것 같다.

3. Discussion:

< 코드 설명 >

코드의 전체적인 틀은 4주차 과제와 동일한 구조를 가지고, DROPOUT과 ADAM Optimizer가 추가된 형태이다. 4주차 과제와 마찬가지로 전체 트레이닝 데이터를 총 15번 학습하게 되고, 전체

트레이닝 데이터가 1번 학습될 때의 batch의 사이즈는 100으로 하여 전체 데이터 숫자인 55000에 100을 나눈 결과인 550만큼 for문을 반복하며 학습하게 된다. 또한 15번 학습을 반복할 때, 전체 트레이닝 데이터에 대한 평균 cost를 출력하도록 하고, 마지막에 최종 test 데이터로 모델의 정확성을 확인하여 이를 수치상으로 출력하도록 해주었다.

또한 MLP의 구조는 각각 784->256->128->256->10개의 뉴런으로 구성되고 총 4개의 Layer로 이뤄져있는 네트워크의 모델로 디자인 하였고, 마지막 Layer를 제외한 나머지 Layer에서는 Activation Function으로 Sigmoid를 사용하고, 마지막 Layer에서는 Softmax를 Activation Function으로 사용하였다. 이때 각 Layer마다 Dropout기능을 추가해 주었는데 Dropout의 확률은 70%로 전체 뉴런 중에서 랜덤한 70%의 뉴런만 active하게 된다.

ADAM Optimizer를 사용할 때는 Beta1=0.6, beta2=0.8, epsilon=0.1, learning_rate=0.9로 설정하여 주었는데, 이 설정 값은 여러 번 변경을 해본 후 결과가 가장 잘 나온다고 생각한 숫자를 대입하여 사용한 것이다.

< 결과 분석 >

앞서 확인한 결과들을 비교해 봤을 때 DROPOUT을 적용하지 않고 Gradient Descent Optimizer를 사용했을 때 DROPOUT을 적용하고 ADAM Optimizer를 사용했을 때보다 더 높은 정확성을 보이게 된다.

이러한 이유로 생각되는 부분은 먼저 Optimizer가 얼마나 빠르고 정확한 값에 수렴하게 해주는지에 따라 다르기 때문이라는 점이다. 일반적인 Gradient Descent의 경우 빠르지만 Local Optimum에 갇힐 우려가 있고 이전 step의 관성의 영향을 받지 않고 새롭게 계산된 방향으로만 최적화하는 경향이 있는 Optimizer이고, ADAM의 경우 Momentum과 RMSProp을 합친 방법으로 이전 step에서의 관성을 어느정도 유지하며, 계속해서 계산해온 기울기의 지수 평균을 저장하여 사용하는 방식이므로 Local Optimum에 빠지는 위험은 덜하나 수렴하는 데에 더 많은 step과 시간이 소요될 수 있다.

위 두가지 Optimizer를 비교하여 생각해 보자면, 단순 Gradient Descent를 사용할 때는 처음 **W**와 **b**를 초기화 해줄 때 아주 작은 범위 안에서 랜덤한 숫자로 초기화 해주기 때문에 Gradient를 계산하는 과정에서 무작위로 Local Optimum에 갇힐 확률이 크지 않다고 생각하고, 또한 Local Optimum에 갇히더라도 그 수렴한 **W**와 **b**값이 충분히 높은 정확성을 낸다면 더이상 Local Optimum이라 생각하지 않아도 된다고 생각한다. 이 의미는 결국 초기화 범위에 크게 변동이 없는 경우 Gradient Descent Optimizer가 빠르게 정확한 솔루션을 찾을 수 있다는 것이다.

반면에 ADAM의 경우 이전 step에서의 관성을 고려하고 계산해온 기울기의 제곱값의 지수평균을 이용한 계산을 하게 되므로 단순한 Gradient Descent 보다 한 Step에서의 연산량이 많아 더 느려진다고 생각하고, 관성을 고려하는 특성 때문에 한 step에 업데이트되는 양과 실제 gradient의 방향 간에 약간의 차이가 존재하므로 정확한 수렴을 위해 더 많은 양의 step이 필요해진다고 생각한다. 이러한 점 때문에 ADAM Optimizer가 GD Optimizer보다 정확성 부분에 있어서 좋지 않은 결과가 나온다고 생각하고, 이러한 점은 ADAM Optimizer의 인자로 들어가는 Beta값과 Epsilon을 조정하면 충분히 더 높은 정확성을 내는 방향으로 개선시킬 수 있다고 생각한다.